# APPENDIX J

# Reports of Special Status Plant Species within the Planning Area

## A BLM Monitoring Reports 1978 through 2007

In 1998, the BLM initiated monitoring of six rare plant species. Monitoring was conducted in spring and summer 1998, spring 1999, spring 2000, spring 2001, and spring 2002. In 2001 and 2002, monitoring was restricted to PMV, Algodones Dunes sunflower, and sand food. Utilizing the study methodology of Westec Services, the dunes were divided into four geographic strata; 34 of the original 66 transects were randomly selected from those strata, and divided into cells. Numbers of rare plants were then recorded within 10 to 15 meters or fixed parallel transects in each of the cells. Abundance classes were assigned for each species in a cell (BLM 2000b). The report compared the responses of six rare plant species, as measured by abundance class data, over all 4 years of monitoring (1977 and 1998–2000). The study concluded that plants are at least as abundant and widespread in the entire dune system as they were in 1977. The report also noted that healthy populations of all six species remain in areas open to recreation, although the aboveground expression of populations of some of these species dramatically fluctuates with precipitation (BLM 2001b).

Monitoring conducted between 1998 and 2002 used an abundance class approach; however, this approach did not result in actual estimates of density and population size. The abundance class approach was replaced in 2003 with a pilot monitoring program to estimate the density and population size of PMV, Algodones Dunes sunflower, and sand food. The monitoring program was conducted in the North Algodones Dunes Wilderness and in the Gecko area of the dunes. The 2003 monitoring program also estimated the canopy cover of the vegetation associated with these species (BLM 2004b).

In 2004, the monitoring program was expanded to all areas of the ISD Planning Area where PMV and Algodones Dunes sunflower were known to occur. Twelve sampling areas were surveyed resulting in density and population size estimates as well as estimates of the canopy cover of the perennial plants associated with the special status plants (BLM 2005d).

In 2005, based on results of the 2004 monitoring program, survey sampling was intensified in order to achieve more precise estimates of the density and population size of PMV. A total of 16 areas were sampled in 2005 also resulting in density and population size estimates as well as estimates of the canopy cover of the perennial plants associated with the special status plants (BLM 2005e).

Monitoring in 2006 was similar to that conducted in 2005. The 2006 survey also included the acquisition of aerial photography, which was used to determine OHV use patterns in PMV habitat and investigate the potential negative correlation between the level of OHV use and the number of PMV plants present (BLM 2006d).

In 2007, a pilot study to determine the feasibility of sampling the seed bank of PMV was initiated with assistance from the USFWS. Five sampling areas were chosen based on the location of the highest densities of PMV discovered in 2005 (BLM 2007c).

The following is a species-by-species summary of BLM monitoring studies conducted between 1998 and 2007.

# A.1 Peirson's Milk-vetch

Abundance was closely tied to precipitation throughout the four years of monitoring. Species abundance was highest in 1998, second highest in 1977, third highest in 1999, and lowest in 2000. This mirrors the ranking of the four growing seasons in terms of average precipitation. Recruitment was possibly high in 1998 and low to nonexistent in 1999 and 2000. Responses of this species were similar in both the closed and open recreation areas across all 4 years of monitoring. Results from monitoring conducted in 2001 and 2002 had similar results as previous years, supporting the conclusion that PMV respond more like an annual than a perennial species (BLM 2004a).

The 2003 pilot monitoring program resulted in PMV population estimates of 59,591 (total population size) within the North Algodones Dunes Wilderness (eight belt transects) and 115,267 in the Gecko area (nine belt transects). Density estimates were 23 plants/hectare (all plants) in the wilderness and about 31 plants/hectare in the Gecko area. The vast majority (99 percent) of plants encountered during 2003 surveys were seedlings, which was considered an anomaly compared to previous years. It was suspected that something, perhaps the temperatures at the time of germination, during the 2002-2003 growing season triggered a much higher germination response than seen in previous survey years (BLM 2004b).

In 2004, an estimated 286,374 PMV plants were found within seven management areas of the ISD SRMA. The estimated density of PMV was 13.5 plants/hectare. Densities were highest in the Ogilby and Gecko areas, with few plants found in the Buttercup and Mammoth Wash areas. As seen in 2003, the majority of plants encountered in 2004 were seedlings and juveniles (94 percent). Fewer plants were observed in the wilderness and Gecko areas in 2004 than in 2003, despite similar rainfall amounts and timing of surveys. The patterns seen in 2003 and 2004 were very different from those seen in previous years (1998 to 2002 monitoring). It was suspected that higher temperatures during germination than experienced in 2003 may account for the

difference. Less than 1 percent of the PMV plants found showed evidence of vehicle damage (likely OHV) (BLM 2005d).

Rainfall in October 2004 likely contributed to a favorable germination and establishment year as seen in surveys conducted in 2005. An estimated 1,831,076 PMV plants were found within seven management areas of the ISD SRMA. The estimated density of PMV in 2005 was 86.3 plants/hectare. Densities were highest in the Ogilby area, with few plants found in the Glamis area. As opposed to 2003 and 2004, approximately 75 percent of plants encountered in 2005 had flowered at the time of transect surveys. The percentage of plants flowering in the spring of 2005 was similar to percentages observed from 1998 to 2002. The majority of plants encountered were less than 1 year old, supporting the contention that PMV typically functions more like an annual than a perennial and that the majority of seeds in the seed bank are likely produced from the current year plants in good rainfall years. Less than 1 percent of the PMV plants found showed evidence of vehicle damage (likely OHV; BLM 2005e).

Rainfall in the 2005-2006 growing season was only about 10 percent of the annual average, with the majority of rainfall occurring in March 2006, likely too late in the season to trigger any significant germination by PMV. An estimated 83,451 PMV plants were found within seven management areas of the ISD SRMA. The estimated density of PMV in 2005 was 3.9 plants/hectare. Densities were highest in the Mammoth Wash area (likely due to early monitoring in this area), with few plants found in the Buttercup area. Approximately 68 percent of plants encountered in 2005 had flowered at the time of transect surveys (BLM 2006d).

In 2006, aerial photography was taken during Presidents Day weekend to determine if a relationship existed between the level of OHV recreation (as measured by vehicle track cover) and the number of PMV plants in an area. A slight negative relationship between OHV recreation and the number of PMV plants was determined; however, this relationship was not statistically significant ($P > 0.05$). More importantly, only one percent of the variability in the number of plants can be explained by OHV recreation. This indicates that other factors that were not examined in the study (e.g., habitat, position in the dunes) likely have a much greater effect than OHV recreation on the spatial variability in PMV abundance (BLM 2006d).

Importance of the PMV seed bank has been researched and shown to be significant for the long term survival of the species. Based on this information, BLM decided to focus the 2007 monitoring efforts on determining the feasibility of estimating the number of PMV seeds in the ISD seed bank. A random sampling methodology was used, resulting in an estimated 53,200,000 seeds in sampled areas, corresponding to a density of 6,356 seeds/hectare. Approximately 30 percent of seeds found on the surface were still contained in pods, while 3 percent of buried seeds were still in pods. Seed densities were found to be highest in the central portion of the ISD (previously called the Adaptive Management Area) and lowest in the Gecko area. Seed densities were significantly

lower in areas where OHV recreation occurs and highest in areas closed to OHV recreation (BLM 2007c).

In 2007, an estimated 293,102 PMV plants were found within seven management areas of the ISD SRMA. The estimated density of PMV was 35 plants/hectare, most were seedlings and juveniles (83 percent). Densities were highest in the Gecko area (BLM 2007c).

## A.2 Algodones Dunes Sunflower

Abundance increased significantly between 1977 and 1998. This increase was the result of a large increase in the values for the open area between 1977 and 1998. There were only slight decreases in abundance for 1999 and 2000. Between 1977 and 1998, the species declined in abundance in the closed area. This could have been the result of lower recruitment of individuals into the population in the closed area. With the exception of 1977, the responses in the open and closed areas were parallel.

The 2003 pilot monitoring program resulted in Algodones Dunes sunflower population estimates of 513,710 (total population size) within the North Algodones Dunes Wilderness (eight belt transects) and 406,391 in the Gecko area (nine belt transects). Density estimates were 198 plants/hectare (all plants) in the wilderness and about 109 plants/hectare in the Gecko area. The majority of Algodones Dunes sunflower plants encountered were also seedlings (similar to PMV), 92 percent. Germination response to the 2002–2003 season was similar to that seen for the PMV (BLM 2004b).

In 2004, an estimated 1,965,298 Algodones Dunes sunflower plants were found within seven management areas of the ISD SRMA. The estimated density of PMV was about 93 plants/hectare. Densities were highest in the Glamis area, with few plants found in the Buttercup area. As seen in 2003, the majority of plants encountered in 2004 were seedlings and juveniles (86 percent). Approximately 0.1 percent of the Algodones Dunes sunflower plants found showed evidence of vehicle—likely OHV—damage (BLM 2005d).

Rainfall in October 2004 likely contributed to a favorable germination and establishment of Algodones Dunes sunflower plants in 2005. An estimated 10 million seedlings germinated, and an estimated 325,122 adult plants were found within seven management areas of the ISD SRMA. Approximately 0.6 percent of the Algodones Dunes sunflower plants found showed evidence of vehicle—likely OHV—damage. The highest percentage of damaged plants was found in the Buttercup area, likely the result of a higher concentration of OHV recreation than in other areas (BLM 2005f).

## A.3 Wiggins' Croton

Abundance in 1977 was about half of 1998. Abundance for 1999 and 2000 was similar to 1998. This increase may represent a real increase in the population size of this species in the dune system. Most of this increase was detected in the open area. Comparison of abundance in the closed and open areas indicate—except for 1977, when abundance was similar for both areas—that abundance in open areas was consistently higher.

## A.4 Giant Spanish Needle

Abundance was highest in 1998, the best rainfall year. However, abundance was second highest in 2000, the lowest rainfall season. The reason for the relatively high abundance in 2000 was unclear. Based on rainfall, it was expected that 1977 would have the second highest abundance. Instead, 1977 abundance ranked third and 1999 ranked last. The abundance between closed and open areas is very similar for 1977, 1998, and 1999, while in 2000 abundance was greater in the closed area. Data also appear to indicate that this species is more common in the northern part of the dunes, independent of whether the area is closed or open.

## A.5 Sand Food

Abundance increased between 1977 and 2000, with the highest abundance registered for 2000, the worst rainfall year. The reason for the relatively high abundance in 2000 was unclear. The second highest abundance was 1998, and 1999 abundance was very close to 1998. Abundance for this species in closed and open areas was the same for 1999. In 1998 and 2000, abundance for the closed areas was higher than open areas. However, this determination may have been due to a limitation in the survey method. In 1998, 1999, and 2000, transects were conducted on foot in the closed area, while those in the open area were run from a dune buggy. Additionally, in 1977, closed areas had lower abundance than open. This, too, may have been due to a limitation in the survey method. The 1977 survey utilized a helicopter in closed areas, not the ideal survey method to detect this cryptic plant.

The 2003 pilot monitoring program resulted in sand food population estimates of 34,440 (total population size) within the North Algodones Dunes Wilderness (nine belt transects) and 13,586 in the Gecko area (nine belt transects). Density estimates were 13 plants/hectare (all plants) in the North Algodones Dunes Wilderness and about four plants/hectare in the Gecko area (BLM 2004b).

In 2004, an estimated 46,470 sand food inflorescences (all that is visible above ground) were found within seven management areas of the ISD SRMA. The majority of plants (highest density) were found in the Mammoth Wash area and wilderness (BLM 2005d).

## A.6 Borrego Milk-vetch

Abundance was essentially the same in 1977 and 1998. No plants at all were found in either 1999 or 2000, a statistically significant decline from 1977 and 1998 levels. Presumably, precipitation was insufficient for growth and establishment in 1999 and 2000. No comparison of abundance between closed and open areas was made, because this taxon did not occur in the closed area.

# B Thomas Olsen Associates Report

In 2001, the American Sand Association (ASA) retained the services of Thomas Olsen Associates to provide an independent assessment of the abundance, distribution, and life history of the PMV at the Imperial Sand Dunes. Additional distribution and abundance data were also collected on five other rare plants. As opposed to the BLM monitoring study, this study was designed to obtain an actual census of PMV. The other five plant species were also counted when they were observed with PMV. A nonprobabilistic survey was employed to determine areas for survey. As a first step in the survey methodology interviews of OHV users, BLM staff, and Border Patrol officers who were familiar with the project area were conducted to determine locations of PMV. The second step included a general reconnaissance of the entire dune areas outside the interim closures and wilderness. The third step consisted of actual intensive surveys of specific areas based on professional knowledge of habitat requirements of the species, reconnaissance information, and feedback from the interviewees (TOA 2001).

The team surveyed by foot and rail within the open areas. When a substantial number of plants were detected, the area was designated as a “site.” A number was assigned to each site, and a team of two to three biologists conducted a census of the plants and recorded other habitat characteristics. Areas that were too small to circumscribe on a map or contained a small number of plants were designated as "points.” Additionally, the team conducted an aerial survey by helicopter of the interim closure areas. Parallel transects or concentric circles of decreasing diameter were flown within each of the closure area boundaries south of SR-78 and a portion of the North Algodones Dunes Wilderness north of the highway.

The survey produced a total of 61 sites and 66 points containing one or more of the rare plants within the dunes. Notable concentrations were found in several areas, which included: 1) the southern portion of the dunes near the international border and west of Buttercup Valley; 2) the area near Patton Valley, south of the large closure and west of the dune peaks; 3) between the small central closure and the large central closure; and 4) the east side of the small central closure.

The general conclusion from this study was that the distribution of the rare plants is dependent on the geomorphology of the dunes, and they tend to be concentrated in

areas where there is relative substrate stability. These are areas located generally on the lee side of the large dunes, in areas where the surface gradually slopes upwards from deep or shallow basins at the base of steep slipfaces. The study also concluded that less than 1 percent of the plants had been affected by OHVs (TOA 2001).

The following is a species-by species summary of the TOA study:

## B.1 Peirson's Milk-vetch

A grand total of 71,926 individual plants were recorded. Occurrences were clustered in general areas, and no PMV was detected in large portions of dunes. Generally, plants were found west of the primary dunes in the open areas. The greatest number of plants found at a single site was 3,994 in the southern border area.

## B.2 Algodones Dunes Sunflower

This species was detected in 31 of 61 PMV sites, for a total count of 1,289, scattered throughout the primary dunes. The greatest estimated number of plants at a single site was 431 individuals.

## B.3 Wiggins' Croton

This species was found at 52 of 61 PMV sites for a total count of 3,614. They were found evenly distributed throughout the open areas, sharing generally the same habitat as PMV.

## B.4 Giant Spanish Needle

This species was found at 47 of 61 PMV sites for a total count of 4,191 individuals. Most of the occurrences were south of the Central Closure #2 and south of I-8.

## B.5 Sand Food

A total of 65 plants were found at nine scattered sites and points, most notably in the Gecko Road area and the area just south of Central Closure #2.

## B.6 Borrego Milk-vetch

The preferred habitat at the Plan Area for the Borrego milk-vetch, which is on the eastern portion of the dune system, was generally not surveyed during this study. However, a single site with 15 individuals was detected on the eastern edge of the dunes.

# C Westec Services, Inc. Report

Westec Services, Inc. carried out the initial survey of rare plants in the ISD under contract with the BLM in 1977. They surveyed for eight rare plants, of which seven were found. To determine species abundance, Westec surveyed 66 west–east, randomly selected parallel transects that were segmented into cells 0.45-mile per side (Westec 1977). It must be noted that the Westec study was not specifically designed to study OHV impacts, and the conclusions are based on a single-year study. The study offered the following conclusions:

- Seedlings of rare species could not be found in "high impact areas," while seedlings of these species were abundant in other areas of the dunes.
- Intensity of OHV use in the dunes appears to be the key factor in impacting dune vegetation. Greatest impact occurs within the heaviest use areas.
- Lower level of "secondary impact" occurs throughout the dunes. However, this sporadic impact appears to decrease with increasing distance from the center of high impact areas.
- Despite the observed impacts, healthy reproducing populations of all rare plant species occurred within the dunes.

# D Luckenbach and Bury Report

The Luckenbach and Bury study conducted in 1983 at the ISD is perhaps one of the most significant studies that systematically addressed OHV impacts to the dune biota. However, the study has limited utility toward drawing conclusions with respect to rare plants, since most of the study plots had none of these species in them. Another limitation is that the study compared sites with heavy OHV use to sites with no OHV use, which does not allow inferences to be made to less heavily used OHV sites. Also, what data were collected showed that PMV density and cover were actually higher in the OHV area than in the closed control area. The following are the conclusions of this study:

- OHV activities in the dunes are highly detrimental to dune biota.
- Both herbaceous and shrubby perennial vegetation is reduced greatly in areas where OHVs operate.
- Most commonly, plants were destroyed by direct destruction or damage to root systems of psammophytic shrubs.

- Changes due to OHV impacts may result in substrate changes, such as compaction, reduced porosity, altered thermal structure, and reduced moisture content, although these effects were not tested.

# E ECOS, Inc. Report

In 1990 Ecos, Inc. was contracted by BLM to perform habitat characterization and rare plant species analysis as well as to design a long-term monitoring plan. This study did not count the total number of plants; instead, the plant population fitness was analyzed by scoring a set of variables for each species. This study concluded that substantially less vegetative cover and species diversity were observed as an effect of OHV use. However, a limitation of this study is that it was conducted in a year of severe drought and that study sites in the open OHV area were located relatively close to OHV staging areas. Therefore, the observations on OHV impacts to plant species do not apply to most of the OHV open area.

# F Phillips Reports

## F.1 2002 Report

In 2001, A.M. Phillips was contracted by the American Sand Association to conduct a study of PMV to obtain further information on the demography and life history of the species. The study was conducted was conducted from November 2001 to February 2002 and included a sampling of the PMV population in which survival of the plants censused in the spring of 2001 was assessed and seed bank data were collected and analyzed. The following are the conclusions of this study:

- PMV underwent an explosive germination event during the winter of 2000–2001, with favorable conditions for germination occurring in October 2000. More than 71,000 plants were censused during field surveys for stage one of this study. Many of these plants flowered and set seed in spring 2001, replenishing the seed bank and demonstrating the potential abundance of the species.

- Such favorable conditions normally occur infrequently, and the time between germination events may be greater than the life span of the plants. Therefore their seeds must be adapted to survive for long periods of dormancy without losing viability. During a growing season such as 2000–2001, the species potential is predominantly expressed as living plants; during a winter such as 2001–2002, the potential is the summation of the living survivors from the last germination event (and prior events) plus the dormant seeds in the soil—the seed bank. The status of the plant at any point in time must be determined by considering both of these factors.

- PMV flowers during the winter, produces seeds in late spring, and becomes mostly dormant during the summer. Because the plants reproduce during their first year, it is not necessary that they survive to a following season to perpetuate the species, adding their progeny to the gene pool. In the spring of 2001 5 out of 71,000 individual were counted that were older than the current season. The overall survival rate of the 2000–2001 cohort through the summer of 2001 was 26 percent. The extraordinarily high survivorship of PMV probably resulted from a rare combination of a major germination event, good rainfall during the ensuing spring, and precipitation during the summer sufficient to maintain soil moisture in the root zone of the plants.

- There was a substantial infusion of seeds into the sand as a result of the 2000 germination event and the favorable weather conditions in the dune system during the spring and summer of 2001, replenishing the PMV seeds that germinated in the fall of 2000 between 35- and 80-fold.

## F.2 2003 Report

In March 2003, the 25 sites sampled in 2002 were visited to ascertain survival of the 2000 cohort of plants to a third season. A series of storms in late February 2003 caused another germination event to occur, with thousands of seedlings appearing in early March. The 2003 germination differed from the 2000 event in that it occurred late in the growing season, providing an opportunity to compare the success of germination events occurring at different times in the growing season. The following are the conclusions of this study:

- Censuses of the 25 sample sites visited in 2002 resulted in a count of more than 33,000 seedlings, 8 percent more than were counted at these sites in the spring of 2001. These late-winter plants had not flowered as of early May, and many were already dying. It is likely that late season germinants do not flower until their second season, in contrast to fall germinants that flower and produce seed in large numbers during their first growing season.

- The February 2003 germination event, which depleted the seed bank by a mere 3 percent, was a more high-risk event both in terms of the time of year it occurred (too late for reproduction to occur during the same growing season as germination) and subsequent weather (no further precipitation). It will not be possible to determine the reproductive success of the 2003 cohort until the 2003–2004 growing season.

- The concept that all seeds in a seed bank do not have the same ecological requirements for germination, and thus will never all germinate at once, is known as “bet-hedging.” This buffers the species against catastrophic depletion if unfavorable conditions follow a germination event, ensuring that some viable seeds always remain in the seed bank. The February 2003 germination illustrates the bet-heading

concept very well: it was a risky germination because it was late in the season, but the ecological cost was very low. If 100 (0.3 percent) of the plants were to survive until the fall of 2003, and each survivor flowers and were to produce 24 pods in the spring of 2004, they would have replaced the 33,000 seeds that germinated in February 2003. A seed bank of 1,000,000 seeds is a hedge with many levels of redundancy built in.

- OHV damage to seedlings was recorded during the 2003 surveys. Seedlings affected by OHVs totaled 1.3 percent of those counted. Most of these were not killed or visibly damaged. Of the 83 surviving perennial plants, five (approximately 6%) showed evidence of OHV damage, consisting primarily of broken branches that did not kill the plants or prevent them from flowering and producing seed. OHVs may damage or kill some plants, but by far most mortality is the result of natural causes, usually inability to survive the hot, dry summer season.

## F.3 2004 Report

The fourth year of the multi-year PMV study was conducted October 2003 through March 2004. The following are the conclusions of this study:

- PMV exhibits an unusual dual reproductive strategy. Plants that germinate in the fall, are capable of reproducing during their first season at levels of at least 45 percent. The second strategy is late winter germination, in February and March, which may equal the fall germination in numbers of plants produced. However, late winter germinants are unable to reproduce during the short remainder of the growing season and put their energy into developing a root system sufficient for surviving the summer season, which apparently is achieved by very few of the seedlings. In December 2003 the survival rate of February 2003 seedlings was 0.05 percent, or 16 individuals out of 33,119 germinants, a high cost germination event in terms of survival.

- The big loss of seeds from the seed bank changes the initial impression that PMV is relatively conservative in producing only seedlings that were likely to succeed in producing progeny. The seed bank reserves are sufficient to allow for germination events to occur in “risky” situations, and the fecundity of the plants producing large numbers of seeds makes it possible for just a few survivors to replenish the seed bank.

- Determination of the status of a desert ephemeral or short-lived perennial must include as assessment of the seed bank and its characteristics as well as the actively growing plants. It is not an easy task to assess the health of short-lived desert plants. All data collected over a four-year period indicate that PMV is a healthy species

surviving the effects of a variable climate and impacts from OHVs without the need for protection or intervention.

## F.4 2005 Report

The following are the conclusions of the fifth year of this multi-year study of PMV funded by the American Sand Association:

- The 2004–2005 season provided further evidence that the population of PMV in open areas of the ISD is healthy and thriving. Overall, the population level in 2004–2005 was over twice as high as in 2001, the first year of the study. Rainfall patterns during each of the five years of our study have been different, and our annual counts of plants compared with climate data show that population is tied to amount and timing of rainfall events.

- Phillips noted that his assertion that first-year PMV plants that germinate in the fall can and do reach reproductive maturity during their first growing season was validated in 2005 when some 20,000 first-year plants were documented as fertile. The seedlings had been followed since November, and an inventory of perennial plants made in December 2004 was used as a baseline of older plants.

- In 2004-05, PMV were more widely distributed in the dunes than in other years, with low-density occurrences often observed between sites where no plants had occurred before, suggesting that a dormant seed bank is widely present in the dunes, probably deposited by windblown pods that were blown beyond optimal sites. The long period of wet sand in 2004–2005 meant that there was less sand movement, and areas that usually experience heavy abrasion by blowing sand and high rates of sand deposition or erosion were more stable. This apparently allowed seedlings to become established outside their normal distribution. This was noted mainly between sites of known occurrence.

## F.5 2006 Report

The field work during the 2005-06 season had two objectives: first, to study the survival and reproduction of plants from previous seasons and any seedlings that grew during the current season, and second, to analyze the seed bank of the species and compare the results with the seed bank study conducted by Phillips in 2002. The following are the conclusions of this study:

- Despite dry conditions, minimal germination and low survival rates, a small number of mature PMV can substantially contribute to the soil seed bank, thus ensuring proliferation of the species.

- Despite diverse weather conditions, and variations in germination and survival rates, the soil seed bank is remarkably stable over time.
- Increases in recreational use have little or no impact on annual fluctuations in PMV population in the ISD.
- The timing and duration of precipitation, along with other climatic factors, is the likely cause of annual variation in plant germination and survival rates.